CLAIMS

1. A process for treating a metal surface to reduce the coefficient of sliding friction thereon, said process comprising operations of:

(I) forming over said metal surface a coating of a liquid composition that before, during, or both before and during drying reacts with said metal surface to produce a modified solid surface with a lower coefficient of sliding friction than said metal surface; and

(II) drying said coating of liquid composition into place on said metal surface over which it was formed in operation (I), without intermediate rinsing,

wherein the improvement comprises using a liquid composition that comprises water and the following components:

(A) dissolved, dispersed, or both dissolved and dispersed organic film-forming resin;

(B) dissolved, dispersed, or both dissolved and dispersed wax that is not part of immediately previously recited component (A); and

(C) dissolved, dispersed, or both dissolved and dispersed hexavalent chromium.

2. A process according to claim 1, wherein the mass of wax component (B) in said liquid composition has a ratio to the mass of resin component (A) in said liquid composition, both of these masses being on a dry basis, that is at least about 0.60:1.0.

3. A process according to claim 2, wherein the mass of the stoichiometric equivalent as CrO_3 of the hexavalent chromium present in said liquid composition has a ratio to the mass, on a dry basis, of the resin component (A) in said liquid composition that is at least about 0.0050:1.0.

4. A process according to claim 3, wherein resin component (A) is selected from the group consisting of polymers of acrylic acid, methacrylic acid, maleic acid, the esters of all of these acids, acrylonitrile, methacrylonitrile, acrylamide, and methacrylamide.

5. A process according to claim 4, wherein wax component (B) is a polyethylene wax with a melting point in a range from about 85 to about 150 °C.

6. A process according to claim 5, wherein:

- the ratio of the mass of wax component (B) to the mass of resin component (A), both on a dry basis, is from about 0.090:1.00 to about 0.15:1.0;
- the ratio of the mass of the stoichiometric equivalent as CrO_3 of the content of hexavalent chromium to the mass, on a dry basis, of resin component (A) is from about 0.0140:1.00 to about 0.030:1.00; and

- during operation (II), the metal substrate reaches a temperature of at least about 88 °C.

7. A process for treating a metal surface to reduce the coefficient of sliding friction thereon, said process comprising operations of:

(I) forming over said metal surface a coating of a liquid composition that before, during, or both before and during drying reacts with said metal surface to produce a modified solid surface with a lower coefficient of sliding friction than said metal surface; and

(II) drying said coating of liquid composition into place on said metal surface over which it was formed in operation (I), without intermediate rinsing,

wherein the improvement comprises using a liquid composition that has been made by mixing with a first mass of water at least the following additional masses:

(A) a second mass of organic film-forming resin that is spontaneously water soluble, dissolved in water, dispersed in water, or any two or more of spontaneousiy water soluble, dissolved in water, and dispersed in water;

(B) a third mass of wax that is not part of said second mass and that is spontaneously water soluble, dissolved in water, dispersed in water, or any two or more of spontaneously water soluble, dissolved in water, and dispersed in water; and

(C) a fourth mass of a source of hexavalent chromium that is spontaneously water soluble, dissolved in water, dispersed in water, or any two or more of spontaneously water soluble, dissolved in water, and dispersed in water.

8. A process according to claim 7, wherein said third mass has a ratio to said second mass that is at least about 0.60:1.0.

9. A process according to claim 8, wherein the mass of the stoichiometric equivalent as CrO_3 of the hexavalent chromium in said fourth mass has a ratio to the mass, on a dry basis, of the resin component (A) in said liquid composition that is at least about 0.0050:1.0.

10. A process according to claim 9, wherein the resin in said second mass is selected from the group consisting of polymers of acrylic acid, methacrylic acid, maleic acid, the esters of all of these acids, acrylonitrile, methacrylonitrile, acrylamide, and methacrylamide.

11. A process according to claim 10, wherein the wax in said third mass is a polyethylene wax with a melting point in a range from about 85 to about 150 °C.

12. A process according to claim 11, wherein:

- the ratio of said third mass to said second mass is from about 0.090:1.00 to about 0.15:1.0;
- the ratio of the mass of the stoichiometric equivalent as CrO_3 of the content of hex-

avalent chromium in said fourth mass to said second mass is from about 0.0140:1.00 to about 0.030:1.00; and

- during operation (II), the metal substrate reaches a temperature of at least about 88 °C.

13. A process according to any one of claims 1 through 12, wherein the dried coating formed in operation (II) contains at least 5 mg/m^2 of chromium.

14. A process according to claim 13, wherein the dried coating formed in operation (II) has a coefficient of sliding friction against stainless steel that is not more than 0.250.

15. A process according to any one of claims 1 through 12, wherein the dried coating formed in operation (II) has a coefficient of sliding friction against stainless steel that is not more than 0.250.

16. A process according to claim 15, wherein the metal substrate surface coated is an alloy of aluminum and zinc.

17. A process according to any one of claims 1 - 12 and 14, wherein the metal substrate surface coated is an alloy of aluminum and zinc.

18. A process according to claim 13, wherein the metal substrate surface coated is an alloy of aluminum and zinc.

19. A process according to any one of claims 1 - 12, wherein said liquid composition further comprises a concentration that is from about 1.0 to about 10 % of the total working composition of a component selected from the group consisting of:

- esters with a structure that can be made by completely esterifying orthophosphoric acid or sulfuric acid with at least one monoalcohol, which may include halogen atoms and/or ether oxygen atoms in its molecules; and
- glycols, polyglycols, and the ethers and esters of glycols and polyglycols, i.e., molecules that conform to the general chemical formula (I):

$$R^1\text{–}O\text{–}R^2\text{–}(OR^3)_n\text{–}O\text{–}R^4 \qquad (I),$$

wherein:

-- each of R^1 and R^4, which may be the same or different, represents one of a hydrogen moiety, a monovalent hydrocarbon, halohydrocarbon, or halocarbon moiety, and a monovalent acyl or halo-substituted acyl moiety;

-- each of R^2 and R^3, which may be the same or different, represents a divalent hydrocarbon, halohydrocarbon, or halocarbon moiety; n represents zero or a positive integer; and

-- the R^3 moiety in any one of the n (OR^3) moieties may be the same as or different from the R^3 moiety in any other distinct one of these (OR^3) moieties.

20. A liquid composition of matter useful as a treatment composition in a process according to claim 6, said liquid composition comprising water and the following components:

(A) a mass of dissolved, dispersed, or both dissolved and dispersed organic film-forming resin;

(B) a mass of dissolved, dispersed, or both dissolved and dispersed wax that is not part of immediately previously recited component (A); and

(C) a mass of dissolved, dispersed, or both dissolved and dispersed hexavalent chromium,

wherein:

- the ratio of the mass of wax component (B) to the mass of resin component (A), both on a dry basis, is from about 0.090:1.00 to about 0.15:1.0; and
- the ratio of the mass of the stoichiometric equivalent as CrO_3 of the mass of hexavalent chromium to the mass, on a dry basis, of resin component (A) is from about 0.0140:1.00 to about 0.030:1.00.

21. A liquid composition of matter useful as a treatment composition in a process according to claim 12, said liquid composition having been made by mixing with a first mass of water at least the following additional masses:

(A) a second mass of organic film-forming resin that is spontaneously water soluble, dissolved in water, dispersed in water, or any two or more of spontaneously water soluble, dissolved in water, and dispersed in water;

(B) a third mass of wax that is not part of said second mass and that is spontaneously water soluble, dissolved in water, dispersed in water, or any two or more of spontaneously water soluble, dissolved in water, and dispersed in water; and

(C) a fourth mass of a source of hexavalent chromium that is spontaneously water soluble, dissolved in water, dispersed in water, or any two or more of spontaneously water soluble, dissolved in water, and dispersed in water,

wherein:

- the ratio of said third mass to said second mass is from about 0.090:1.00 to about 0.15:1.0;
- the ratio of the mass of the stoichiometric equivalent as CrO_3 of the content of hexavalent chromium in said fourth mass to said second mass is from about 0.0140:1.00 to about 0.030:1.00.